
Merger of the Endemic Hawaiian Genera *Cyanea* and *Rollandia* (Campanulaceae: Lobelioideae)

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ABSTRACT. Phylogenetic analyses based on molecular data indicate that the species of *Rollandia* are embedded within the genus *Cyanea* and that together these genera form a monophyletic group. *Cyanea* and *Rollandia* are therefore merged under the former name. A revised key to the baccate genera of Hawaiian Lobelioideae and an expanded description of the genus are provided; eight new combinations and one new name are proposed; and lectotypes are selected for *Rollandia humboldtiana* and *R. longiflora* var. *angustifolia*. This expanded circumscription makes *Cyanea* the largest genus in the Hawaiian flora, with 64 species and 10 heteronymic subspecies.

The flora of the Hawaiian Islands includes 114 endemic species of woody Lobelioideae (Campanulaceae), 95 of which have baccate fruits (Lammers, 1990, 1992a; Lammers & Lorence, 1993). Traditionally (Gaudichaud, 1826; Bentham & Hooker, 1876; Hillebrand, 1888; Schönland, 1889; Rock, 1919; Wimmer, 1943), these baccate species have been divided among four genera: *Clermontia* Gaudichaud, *Cyanea* Gaudichaud, *Delissea* Gaudichaud, and *Rollandia* Gaudichaud. However, various alternative classifications have been proposed. Presl (1836) and de Candolle (1839) recognized a fifth genus, *Macrochilus* C. Presl. Gray (1861), however, recognized only three; *Macrochilus* was included in *Cyanea* and the species of *Rollandia* were divided between *Cyanea* and *Delissea*. Endlicher (1836) and Dietrich (1839), taking a very broad view of generic circumscription, assigned all Hawaiian lobelioids to cosmopolitan *Lobelia* L. Bailon (1885), on the other hand, treated the baccate Hawaiian species as a single genus, *Delissea*, with the four traditional genera as sections. The classification of von Post and Kuntze (1903) was similar, except *Rollandia* was maintained as distinct. St. John (1987) merged *Cyanea* and *Delissea* under the latter name, but maintained *Clermontia* and

Rollandia as distinct genera. The traditional four-genus classification was employed in the most recent taxonomic summary of the Hawaiian Campanulaceae (Lammers, 1990).

Recent phylogenetic analyses based on restriction site variation in the chloroplast DNA of Hawaiian lobelioids (Givnish et al., in press) have shown that the species comprising *Rollandia* are embedded within *Cyanea* as traditionally circumscribed, that *Cyanea* without *Rollandia* is paraphyletic, and that the two genera together form a monophyletic group. Specifically, *Rollandia* is part of a major clade that is defined by 10 synapomorphic mutations and generally characterized by orange fruits and an unbranched habit. Within this major clade, *Rollandia* forms an unresolved clade defined by three mutations.

Morphologically, the two genera are very similar. Every author for over 100 years has distinguished *Rollandia* solely on the basis of a single feature, i.e., the adnation of the staminal column to the corolla (Hillebrand, 1888; Schönland, 1889; von Post & Kuntze, 1903; Rock, 1919; Wimmer, 1943; Lammers, 1990). The traditional classification of Campanulaceae includes several such cases of closely related genera distinguished by a single morphological feature, e.g., *Campanumoea* Blume and *Codonopsis* Wallich, *Lobelia* and *Pratia* Gaudichaud. The circumscription of such genera must be revised if a natural classification of the family is ever to be achieved (Lammers, 1992b, c).

In order to provide a more natural classification of the baccate Hawaiian lobelioids, *Cyanea* and *Rollandia* are here merged. Although Gray (1861) transferred some species of *Rollandia* to *Cyanea*, the species that was later designated as the lectotype of the genus (*R. lanceolata*) was assigned to *Delissea*. Because no previous author has effectively merged just *Cyanea* and *Rollandia*, and because the two generic names are of equal priority, we have the prerogative of choosing the name to be retained.

We here choose *Cyanea*, as doing so will require far fewer nomenclatural innovations.

The eight species of *Rollandia* (one comprising two subspecies) recognized by Lammers (1990) are here transferred to *Cyanea* with no change in their circumscription or rank. In addition, lectotypes are designated for two inadequately typified names. Descriptions, distributional and habitat data, and lists of heterotypic synonyms are found in Lammers's (1990) treatment and will be amplified in the forthcoming monograph of *Cyanea* (Lammers, in prep.). Assignment of these species to an infrageneric taxon within *Cyanea* is problematic. As noted previously (Lammers, 1990), the infrageneric classification of *Cyanea* is badly in need of revision. The genus has been divided into either three (Hillebrand, 1888; Wimmer, 1943; St. John, 1969) or five sections (Rock, 1919; Stone, 1967). Neither classification maps cleanly onto the molecular clades defined by Givnish et al. (in press); for example, *Cyanea* sect. *Palmiformes* (Hillebrand) Rock comprises species belonging to at least three different clades. A definite infrageneric assignment is deferred, therefore, pending completion of a comprehensive reevaluation of relationships within the enlarged *Cyanea*.

This merger makes *Cyanea* the largest genus in the Hawaiian flora, with 64 species and 10 heteronymic subspecies (Wagner et al., 1990; Lammers & Lorence, 1993). A morphological description of the newly enlarged genus is provided below, as is a revised key to all of the Hawaiian genera of Lobelioideae with baccate fruit. Both are adapted from Lammers (1990).

A brief comment on the spelling of Hawaiian place names in the specimen citations is in order. The spellings adopted here are those given by Pukui et al. (1974), in which the macron (ˉ) is used to indicate long vowels and the hamza (ʻ) to indicate glottal stops. Although non-Polynesian authors are often tempted to omit these diacritical marks, doing so is a grammatical gaffe comparable to omitting the umlauts from German words or the tildes from Spanish ones.

REVISED KEY TO THE BACCATE HAWAIIAN GENERA OF LOBELIOIDEAE

- 1a. Stems repeatedly branched, spreading; inflorescences (1–)2–3(–10)-flowered; corolla cleft dorsally nearly to base *Clermontia*
- 1b. Stems unbranched or only sparingly branched, erect or ascending; inflorescences (3–)5–25(–40)-flowered; corolla cleft to about the middle.
 - 2a. Corolla with a small knob at the terminus of the dorsal cleft, sometimes with two additional lateral knobs; seeds 0.7–1.5 mm long, white, dull, conspicuously transversely rugose *Delissea*
 - 2b. Corolla smooth or rarely muricate, without definite dorsal or lateral knobs; seeds 0.2–0.5(–2) mm long, dark brown to black, shiny, smooth or microscopically foveate-reticulate *Cyanea*

Cyanea Gaudichaud, Voy. Uranie 457. 1829. *Delissea* sect. *Cyanea* (Gaudichaud) Baillon, Hist. Pl. 8: 364. 1885. *Kittelina* H. G. L. Reichenbach, Handb. Nat. Pfl.-Syst. 186. 1837, nom. illeg. TYPE: *Cyanea grimesiana* Gaudichaud.

Rollandia Gaudichaud, Voy. Uranie 458. 1829, syn. nov. *Delissea* sect. *Rollandia* (Gaudichaud) Baillon, Hist. Pl. 8: 364. 1885. TYPE: *Rollandia lanceolata* Gaudichaud (selected by Rock (1919: 363)).

Macrochilus C. Presl, Prodr. Monogr. Lobel. 47. 1836. TYPE: *Macrochilus superbus* (Chamisso) C. Presl (based on *Lobelia superba* Chamisso).

Shrubs, treelets, or trees, rarely lianas, terrestrial or rarely epiphytic; stems unbranched or sparingly branched, erect or ascending, unarmed, muricate, or aculeate (more so in juveniles), with numerous helically arranged leaf scars near apex; pith solid or chambered; latex white, yellow, or tan, viscous. Leaves alternate, petiolate or sessile, glabrous or pubescent, sometimes muricate or aculeate, especially on the petiole; margin entire, callose-toothed, or pinnately lobed, cleft, parted, or divided (more so in juveniles), the lobes or segments then entire, callose-toothed, lobed, or divided. Inflorescences axillary, racemose, (3–)5–25(–40)-flowered, the rachis sometimes obsolete and the raceme thus appearing subumbellate. Flowers epigynous, resupinate, protandrous. Calyx synsepalous; tube adnate to the ovary, forming a hypanthium, obconic or obovoid, rarely ovoid, oblong, cylindrical, or depressed obovoid; lobes 5, valvate, persistent, dentiform, triangular, or oblong, rarely linear, distinct or rarely connate, much shorter to somewhat longer than the hypanthium, rarely as long as the corolla. Corolla zygomorphic, bilabiate or unilabiate, white or various shades of magenta, purple, or pink, rarely greenish or yellowish, sometimes longitudinally striped, glabrous or pubescent, rarely muricate; tube suberect, curved, arcuate, or sigmoid, dorsally cleft to about the middle; lobes 5, valvate, spreading, deflexed, or rarely erect. Stamens 5, syngenesious, included or exserted; filaments connate, free from the corolla or dorsally adnate for $\frac{1}{3}$ – $\frac{1}{2}$ its length; anthers connate, dithecal, opening introrsely by longitudinal slits, the 3 dorsal ones a little longer than the 2 ventral ones, the latter or rarely all 5 with apical tufts of white hairs; pollen tricolporate, prolate, ellipsoidal. Ovary 2-loculed; placentae large, axile; style slen-

der, terete, with a ring of stiff white hairs near the apex; stigma 2-lobed, the lobes appressed and non-receptive as the style grows through the anther tube, pushing out pollen, after which the stigmas spread and become receptive. Fruit a yellow, orange, or purple berry. Seeds numerous, small, dark brown to black, shiny, smooth or microscopically foveate-reticulate. Chromosome number $n = 14$ (Lammers, 1988).

Cyanea crispa (Gaudichaud) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia crispa* Gaudichaud, Voy. Uranie 459. 1829. *Lobelia crispa* (Gaudichaud) Endlicher, Ann. Wiener Mus. Naturgesch. 1: 170. 1836; not Graham, Edinburgh New Philos. J. 1: 173. 1826. *Cyanea rollandia* A. Gray, Proc. Amer. Acad. Arts 5: 149. 1861, nom. illeg. TYPE: "Iles Sandwich.,," Gaudichaud s.n. (holotype, P).

Based on Gaudichaud's itinerary (St. John & Titcomb, 1983) and the known range of the species (Lammers, 1990), the holotype probably was collected on O'ahu, in the Ko'olau Mountains above Honolulu, during 26–29 August 1819.

Cyanea humboldtiana (Gaudichaud) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia humboldtiana* Gaudichaud, Voy. Bonite, Bot., pl. 76. 1842. TYPE: "Iles Sandwich.,," Oct. 1836, Gaudichaud s.n. (lectotype, selected here, W).

Both Rock (1919) and St. John (1940) failed to locate type material of this species among Gaudichaud's specimens at P; Lammers likewise was unable to find any during a visit in September 1987. However, he did discover one sheet of original material at W, which is here designated as the lectotype. Based on Gaudichaud's itinerary (Lasègue, 1845) and the known range of the species (Lammers, 1990), the type probably was collected on O'ahu, in the Ko'olau Mountains above Honolulu.

Cyanea koolauensis Lammers, Givnish & Sytsma, nom. nov. Replaced name: *Rollandia angustifolia* (Hillebrand) Rock, Bull. Torrey Bot. Club 45: 136. 1918; not *Cyanea angustifolia* (Chamisso) Hillebrand, Fl. Hawaiian Isl. 253. 1888. Basionym of replaced name: *Rollandia longiflora* var. *angustifolia* Hillebrand, Fl. Hawaiian Isl. 246. 1888. TYPE: Hawaii. O'ahu: Pālolo Valley, Hillebrand s.n. (lectotype, selected here, BISH).

Only one other syntype, a sheet at GH labeled "Oahu from Manoa Eastward," has been seen by Lammers. A specimen at B cited by Rock (1918, 1919) could not be located; presumably, it was among those destroyed when the herbarium burned in 1943 (Hiepko, 1987).

Cyanea lanceolata (Gaudichaud) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia lanceolata* Gaudichaud, Voy. Uranie 458. 1829. *Lobelia lanceolata* (Gaudichaud) Hooker & Arnott, Bot. Beechey Voy. 88. 1832; not Hooker & Arnott, Bot. Beechey Voy. 301. 1838; nor Kuntze, Revis. Gen. Pl. 378. 1891. *Lobelia rollandia* Gaudichaud ex D. Dietrich, Syn. Pl. 1: 728. 1839, nom. illeg. *Delissea lanceolata* (Gaudichaud) A. Gray, Proc. Amer. Acad. Arts 5: 147. 1861. TYPE: "Iles Sandwich.,," Gaudichaud s.n. (holotype, P; isotype, G).

Based on Gaudichaud's itinerary (St. John & Titcomb, 1983) and the known range of the species (Lammers, 1990), the type probably was collected on O'ahu, in the Ko'olau Mountains above Honolulu, during 26–29 August 1819.

Cyanea lanceolata* subsp. *calycina (Chamisso) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Lobelia calycina* Chamisso, Linnaea 8: 222. 1833. *Rollandia calycina* (Chamisso) G. Don, Gen. Hist. 3: 699. 1834. *Delissea calycina* (Chamisso) C. Presl, Prodr. Monogr. Lobel. 47. 1836. *Rollandia lanceolata* subsp. *calycina* (Chamisso) Lammers, Syst. Bot. 13: 507. 1988. TYPE: Hawaii. "O Wahu" [i.e., O'ahu]: Chamisso s.n. (holotype, LE).

Cyanea longiflora (Wawra) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia longiflora* Wawra, Flora 56: 44. 1873. TYPE: Hawaii. O'ahu: leg. Hillebrand, Wawra 2285 (holotype, W).

Cyanea parvifolia (C. Forbes) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia parvifolia* C. Forbes, Occas. Pap. Bernice Pauahi Bishop Mus. 5: 10. 1911. TYPE: Hawaii. Kaua'i: Wai'oli Valley, 1 Aug. 1909, Forbes 103.K (holotype, BISH).

Cyanea purpurellifolia (Rock) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia purpurellifolia* Rock, Coll. Hawaii Publ. Bull. 2: 44. 1913. TYPE: Hawaii. O'ahu: Hau'ula ridge, Punalu'u Mts., 2,000 ft., Aug.

1911, *Rock 8824* (holotype, BISH; isotypes, BISH, GH, K, W).

Cyanea st.-johnii (Hosaka) Lammers, Givnish & Sytsma, comb. nov. Basionym: *Rollandia st.-johnii* Hosaka, *Occas. Pap. Bernice Pauahi Bishop Mus.* 11(13): 14. 1935. TYPE: Hawaii. O'ahu: Ko'olau Range, Waipi'o, Kīpapa Gulch, wet windswept main divide, 2,800 ft., 6 Aug. 1933, *Hosaka 1159* (holotype, BISH).

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